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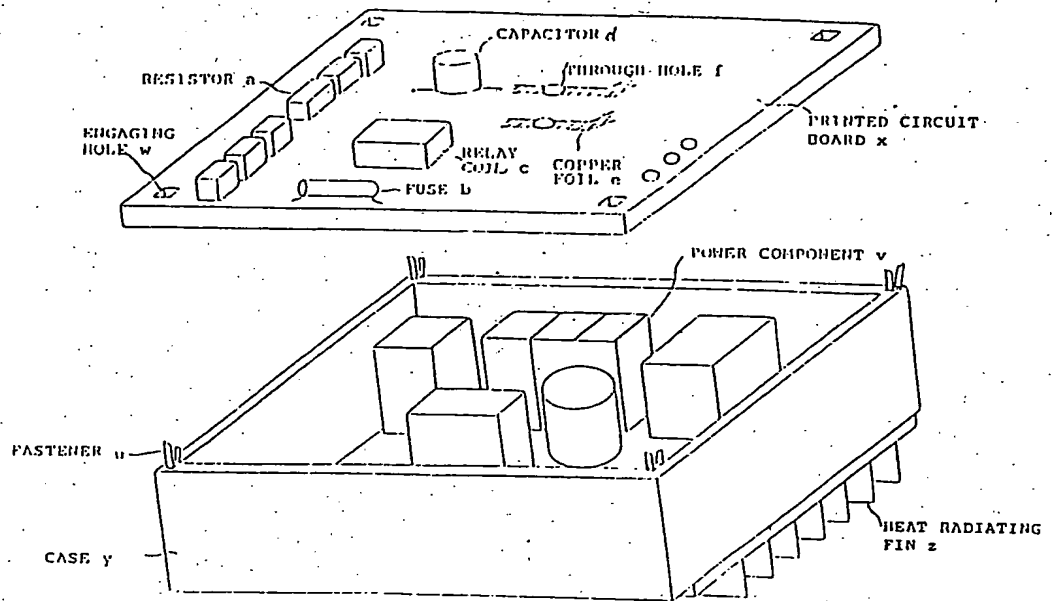
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(54) CONTROL UNIT.

(57) A control unit for AC motors comprising a plastic casing (y) having a plurality of mounting holes of an equal size formed in the bottom surface and a plurality of fasteners (u) provided at the upper edge, large power components (v) that are contained in the casing (y), that have current-carrying terminals of an equal size at the upper portions, and that are screwed down to the mounting holes, a printed circuit board (x) that is equipped with control components (a to d) and that is fastened by fasteners (u), and radiation fins (z). The control unit is assembled by a manipulator.

EP 0 290 617 A1

Fig. 1



DESCRIPTIONCONTROL UNITTechnical Field

5 This invention relates to a control unit in which a plastic case houses power components such as the transistors of an inverter and a smoothing capacitor that are used in an AC motor control apparatus or the like.

Background Art

10 A control apparatus for an AC motor which drives the spindle of a machine tool uses the circuitry shown in Fig. 4. In order to house this control apparatus in a case, it is necessary to have terminals for the illustrated three-phase power supply R, S, T, terminals  
15 U, V, W for feeding current to an AC motor, a ground terminal G, and terminals  $T_2-1$ ,  $T_2-2$  for a thermistat H. Principal components such as an electromagnetic contactor A, rectifying diode B, smoothing capacitor C, regenerative transistor D, transistor inverter E and  
20 filter F are disposed inside the case, and a number of control elements such as resistors, capacitors, fuses and diodes are disposed in the case and connected to control lines.

25 Control components of this kind are fixed to a mounting board by tightening screws and conductive portions are connected as by soldering, after which the components are accommodated within the case, which is made of metal. In this case, it is necessary to mount

a number of components which differ in size, and assembly is carried out manually by a skilled worker. A problem that results is poor operating efficiency. Furthermore, since the case is made of metal, the case is heavy and high in cost. Since the sizes of the circuit components differ depending upon the current capacity of the motor, cases of different size must be fabricated. The result is poor productivity.

#### Disclosure of the Invention

The present invention has been devised in order to solve the foregoing problems and its object is to provide a control unit in which cost can be reduced by improving upon the case for the control apparatus.

In accordance with the present invention, there is provided a control unit characterized by comprising a plastic case having a bottom portion provided at predetermined locations with ribs and a plurality of mounting holes of the same size and an upper portion provided with a predetermined number of engaging members, a plurality of power components such as transistors housed in said case and fixed at the mounting holes by screws and each being provided at an upper portion with energizing terminals of the same size, a printed circuit board having a back side on which there is formed a circuit pattern which contacts the energizing terminals of the power components and a front side on which circuit components such as resistors are disposed, the printed circuit board being

fixed to the case by inserting the engaging members of the case in engaging holes, and heat radiating fins selected to have a predetermined heat capacity and fixed to the case so as to be freely attachable and detachable.

Thus, in the control unit of the present invention, the bottom of the plastic case is provided with mounting holes at positions which are changed depending upon the sizes of the power components, the power components are fixed to the case by screws of the same size, the energizing terminals of each of the power components have a common size, and the case and printed circuit board are fixed by the engaging holes of the printed circuit board and the engaging members of the case. As a result, there is obtained a control unit which is light in weight and capable of being assembled automatically by a robot. In addition, by suitably selecting the power components and the heat radiating fins and then attaching them to the case, control units having a variety of current capacities can be realized using the same case.

#### Brief Description of the Drawings

Fig. 1 is a perspective view illustrating the general construction of a control unit according to the present invention, Fig. 2 is a view of the bottom of a case, Fig. 3 is a view illustrating power components mounted inside the case, and Fig. 4 is a circuit diagram illustrating a control circuit of an AC motor.

Best Mode for Carrying Out the Invention

An embodiment of the present invention will now be described in detail with reference to the drawings.

Fig. 1 is a view showing the general construction of the present invention. In the present invention, a case y is formed of plastic and accommodates power components v, such as the electromagnetic contactor A, rectifying diode B, smoothing capacitor C, regenerative transistor D, transistor inverter E and filter F, which are shown in Fig. 4. These components are attached to ribs formed on the bottom of the case. Besides the power components v, control components such as a resistor a, fuse b, relay coil c and capacitor d are formed on a printed circuit board x at predetermined positions. Both side surfaces of the printed circuit board are provided with wiring patterns comprising copper foil, and connections are made via through-holes subjected to electroplating or the like.

Fasteners u projecting from the case y are inserted into engaging holes w of the printed circuit board thus formed, thereby fixing the case and the printed circuit board to each other. Energizing terminals attached to the power components v and the copper foil formed on the back side of the printed circuit board are brought into contact to obtain an energizing circuit. Heat radiating fins z are attached to the lower portion of the case y by mounting screws so as to be freely attachable and detachable.

Thus, the case y, printed circuit board x and heat radiating fins z construct the control unit of the present invention.

Fig. 2 is a view of the bottom of the case. The bottom is provided with prescribed ribs g as by molding. The positions of mounting holes are changed in accordance with the sizes of the power components, and the sizes of the mounting screws for mounting the power components are the same. Therefore, the same case can be utilized even if AC motors have current capacities that differ from one another. Since the number of components inside the case is small, automated assembly by robot can be carried out in simple fashion.

Fig. 3 is a view showing the power components housed inside the case. Energizing terminals i of the power components are also of the same size so that mounting by robot can be performed in a simple manner.

In accordance with the present invention, the case can be made light in weight, the mounting screws for mounting the power components to the case are of the same size, and so are the energizing terminals. As a result, the mounting of the power components within the case, the attaching of the energizing terminals to the power components, and the joining of the case and printed circuit board can all be carried out automatically by a robot. In addition, the positions of the holes for mounting the components to the case



are changed in accordance with the current capacity of the AC motor, and heat radiating fins suitably selected for heat capacity are attached, thereby enabling power components of different sizes to be housed within a case of the same size. The case can be mass-produced to make possible a reduction in manufacturing cost.

Though the present invention has been described with regard to an embodiment thereof, different embodiments can readily be made without departing from the spirit of the invention. Therefore, it is to be understood that the invention is not limited to the specific embodiment thereof except as defined in the scope of the claims.

#### Industrial Applicability

The control unit of the present invention can be used in an AC motor control apparatus or the like in which a plastic case houses power components such as the transistors of an inverter and a smoothing capacitor.

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CLAIMS:

## 1. A control unit comprising:

5 a plastic case having a bottom portion provided at predetermined locations with ribs and a plurality of mounting holes of the same size, and an upper portion provided with a predetermined number of engaging members;

10 a plurality of power components such as transistors housed in said case and fixed at said mounting holes by screws and each being provided at an upper portion with energizing terminals of the same size;

15 a printed circuit board having a back side on which there is formed a circuit pattern which contacts the energizing terminals of said power components and a front side on which circuit components such as resistors are disposed, said printed circuit board being fixed to the case by inserting the engaging members of said case in engaging holes; and

20 heat radiating fins selected to have a predetermined heat capacity and fixed to the case so as to be freely attachable and detachable.

25 2. A control unit according to claim 1, characterized in that said power components includes an electromagnetic contactor, a rectifying diode, a smoothing capacitor, a regenerative transistor and a transistor inverter.

3. A control unit according to claims 1 and 2,

characterized in that said printed circuit board has wiring patterns comprising copper foil provided on both surfaces thereof, said patterns being connected by through-holes subjected to electroplating or the like.

- 5 4. A control unit according to claims 1 through 3, characterized in that said heat radiating fins are selected to have a suitable heat capacity in dependence upon the current capacity of the power components.

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Fig. 1

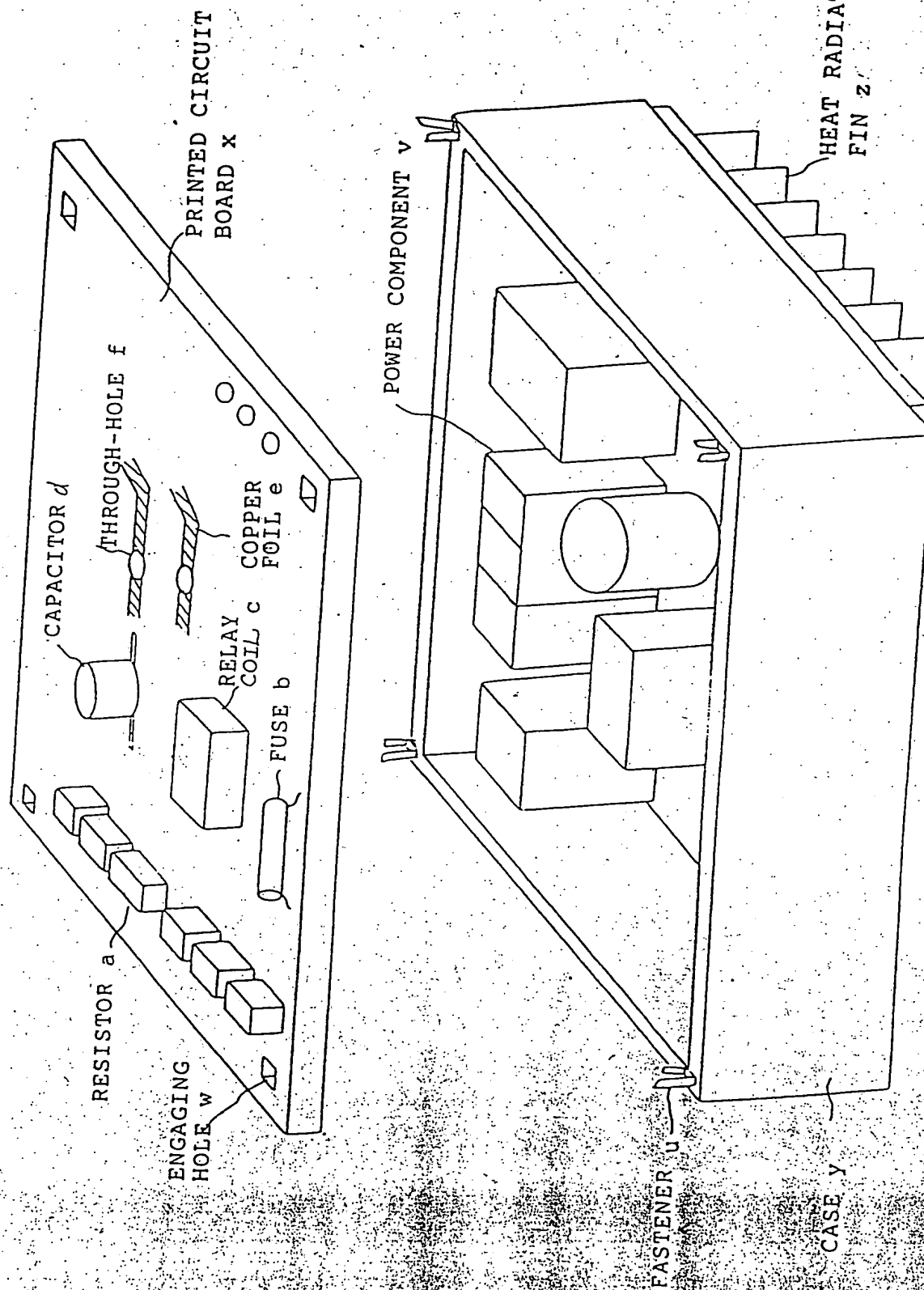
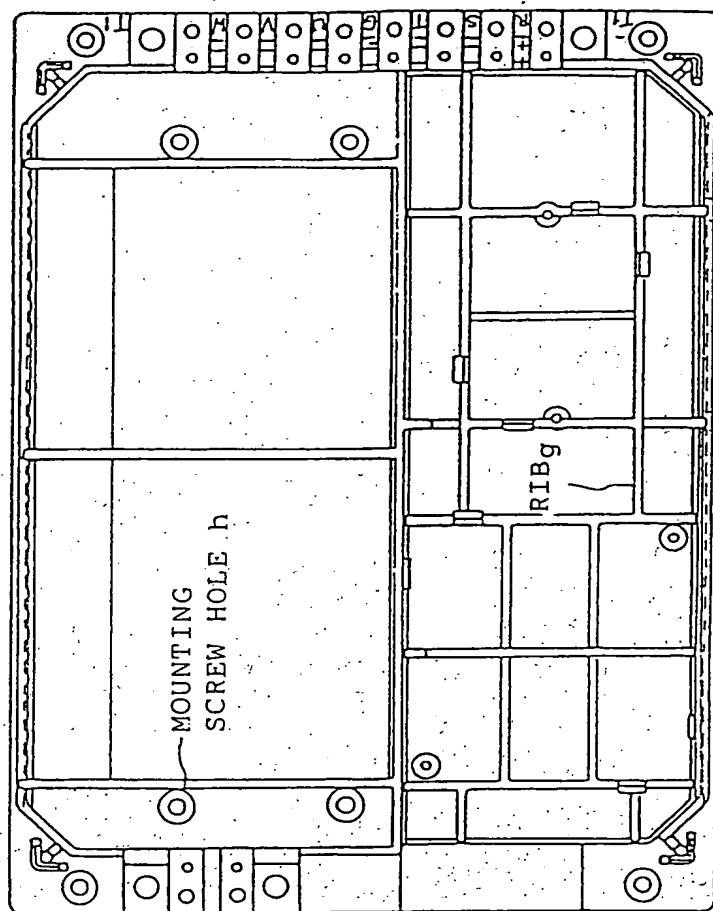


Fig. 2



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Fig. 3

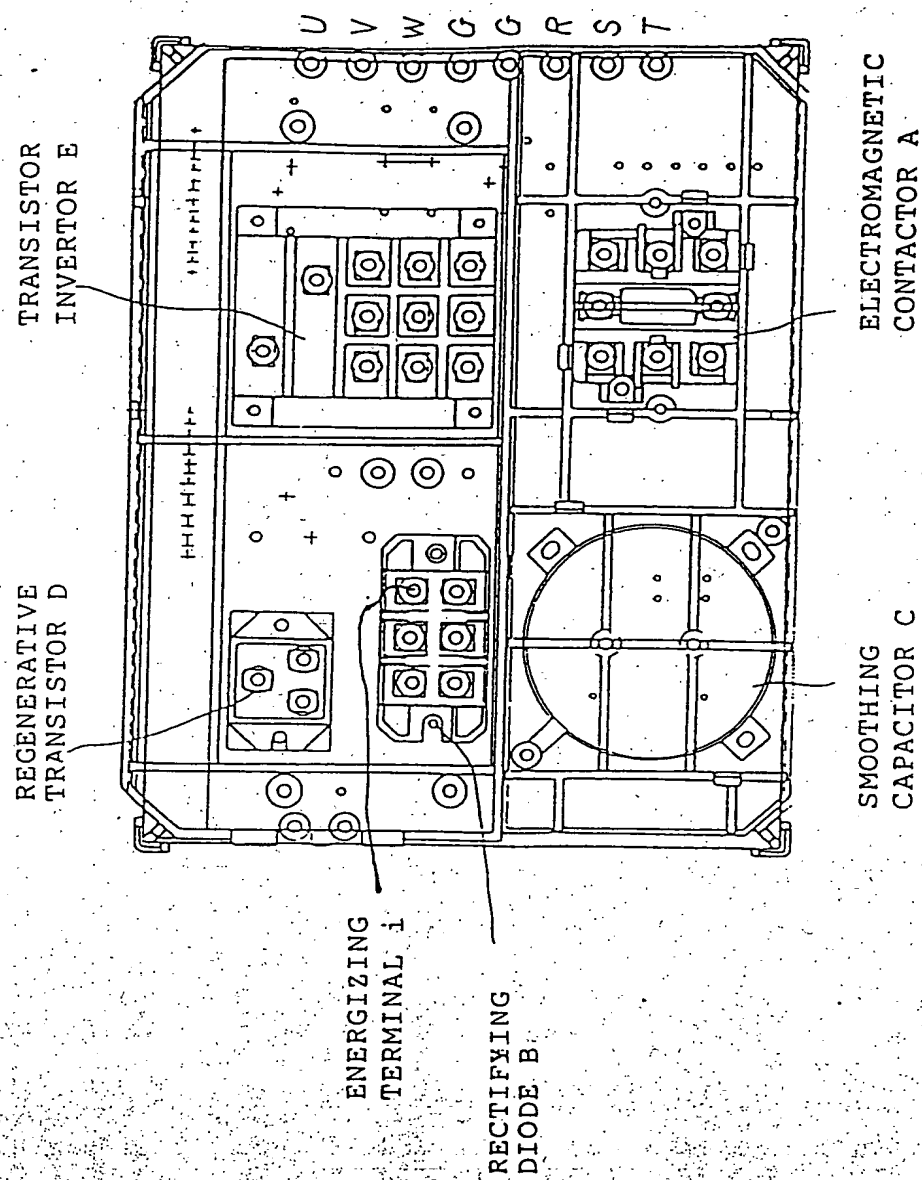
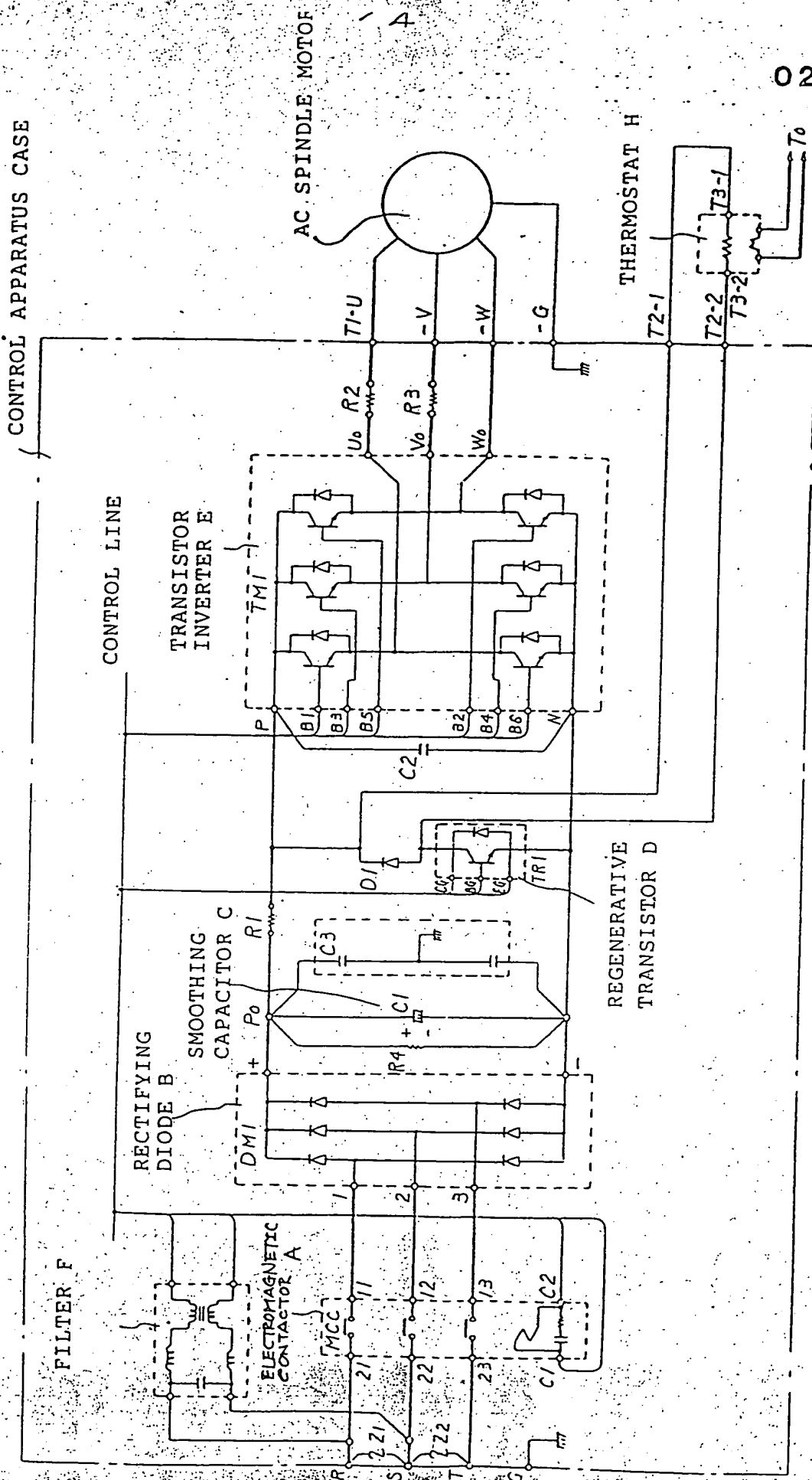


Fig. 4



0290617

## INTERNATIONAL SEARCH REPORT

International Application No PCT/JP87/00848

## I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) \*

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl<sup>4</sup> H05K7/02, 7/20

## II. FIELDS SEARCHED

## Minimum Documentation Searched \*

Classification System

Classification Symbols

IPC

H05K7/02, 7/20

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched \*Jitsuyo Shinan Koho  
Kokai Jitsuyo Shinan Koho1926 - 1987  
1971 - 1987III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>14</sup>

Category *	Citation of Document, <sup>15</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>
Y	JP, A, 61-4172 (Fanuc Ltd.) 10 January 1986 (10. 01. 86) Column 3, line 13 to column 4, line 15 & WO, A, 86/00490	1, 2
Y	JP, Y2, 58-16188 (Matsushita Electric Works, Ltd.) 1 April 1983 (01. 04. 83) Column 2, lines 7 to 23 (Family: none)	1, 3
Y	JP, U, 58-106998 (NEC Corporation) 21 July 1983 (21. 07. 83) Column 2, lines 12 to 14 (Family: none)	1, 4

\* Special categories of cited documents: <sup>16</sup>"A" document defining the general state of the art which is not  
considered to be of particular relevance"E" earlier document but published on or after the international  
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combination being obvious to a person skilled in the art

"Δ" document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search <sup>19</sup>

January 18, 1988 (18. 01. 88)

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Japanese Patent Office

Signature of Authorized Officer <sup>22</sup>